

**Before the
Federal Communications Commission
Washington, D.C. 20554**

In the Matter of)	
)	
Update to Parts 2 and 25 Concerning Non-)	IB Docket No. 16-408
Geostationary, Fixed-Satellite Service Systems)	
and Related Matters)	

REPLY COMMENTS OF SES S.A. AND O3B LIMITED

Ari Q. Fitzgerald
Camillie Landrón
HOGAN LOVELLS US LLP
555 Thirteenth Street, N.W.
Washington, DC 20004

Counsel to O3b Limited

Suzanne Malloy
Vice President of Regulatory Affairs
Mariah Shuman
Director, Maritime & International Regulatory
Affairs
O3b Limited
900 17th Street, N.W., Suite 300
Washington, DC 20006

Petra A. Vorwig
Senior Legal & Regulatory Counsel
for SES S.A.
1129 20th Street N.W., Suite 1000
Washington, DC 20036

April 10, 2017

TABLE OF CONTENTS

I.	THE SATELLITE INDUSTRY SUPPORTS THE EXPANSION OF SPECTRUM ACCESS FOR FSS SATELLITES IN THE KA-BAND.	2
A.	Revisions to the Ka-Band Plan	2
B.	Codification.....	13
II.	THE COMMISSION SHOULD AMEND THE DEFAULT SHARING RULES IN SECTION 25.156(d)(5).	14
III.	TECHNICAL ISSUES.....	15
A.	Power Limits to Protect Terrestrial Operations	16
B.	Power Limits to Protect GSO Operations	18
C.	Avoidance of In-line Interference	19
D.	Earth Station and Space Station Power Limits	27
IV.	OPERATIONAL MILESTONES SHOULD ALLOW FOR PREDICTABILITY AND FLEXIBILITY AMONG ALL NGSO OPERATORS	30
V.	THE NGSO FSS GLOBAL COVERAGE REQUIREMENT SHOULD BE ELIMINATED.....	36
VI.	CONCLUSION.....	37

SUMMARY

SES S.A. (“SES”) and its subsidiary O3b Limited (“O3b”) (together, “the Companies”) commend the Commission’s efforts to facilitate the deployment of non-geostationary orbit (“NGSO”) fixed-satellite service (“FSS”) systems and expand access to spectrum for all FSS operators. With the modifications suggested or supported by the Companies, many of the Commission’s proposals for allowing increased FSS access to the Ka-band spectrum will allow the Companies and other NGSO and geostationary satellite orbit (“GSO”) FSS operators to continue developing and offering innovative services in established, underserved, and unserved markets. SES and O3b also support a number of the Commission’s proposals aimed at removing unnecessary regulations, which will ensure both new and existing satellite services can thrive.

Specifically, the Commission’s proposals to add FSS spectrum allocations in the 17.8-20.2 GHz and 29.3-29.5 GHz bands, subject to the appropriate technical limitations discussed in the Companies’ Comments and these Reply Comments, will accomplish the Commission’s goal of expanding access to spectrum for FSS operators without harming existing operations. But, as urged by several commenters in this proceeding, the Commission should go further. The Commission should allow NGSO and GSO FSS access to the 17.8-18.3 GHz band on a co-primary basis with the fixed service for the operation of individually licensed earth stations and access on a secondary basis for blanket licensed earth stations. The Commission should also allow NGSO and GSO FSS access to the 19.4-19.6 GHz and 29.1-29.25 GHz bands, and NGSO FSS access in the 29.25-29.3 GHz band, which will put underutilized spectrum to more intensive use. The Commission should not, however, authorize GSO FSS operations on a co-primary basis with NGSO FSS operations in the 18.8-19.3 GHz or the 28.6-29.1 GHz bands. This would undermine the investment-backed expectations of NGSO FSS operators and materially disrupt

O3b's operations.

Many commenters, including the Companies, agree that ITU-adopted power flux density ("PFD") and equivalent power flux-density ("EPFD") limits for FSS operations are sufficient to protect primary fixed service operations in the 17.8-18.3 GHz band. The ITU-adopted EPFD limits are similarly sufficient to protect GSO operations in the 17.8-18.6 GHz, 19.3-19.4 GHz, 19.6-19.7 GHz, 19.7-20.2 GHz, 27.5-28.6 GHz, 29.1-29.5, and 29.5-30 GHz bands. The Companies and several commenters also support the adoption of off-axis uplink equivalent isotropically radiated power ("EIRP") and downlink PFD limits for NGSO FSS operations to facilitate sharing between NGSO FSS systems.

There is also significant support in the record for the Commission's proposals to adopt default procedures—rather than band-splitting procedures—to avoid in-line interference among NGSO FSS systems in the bands proposed for NGSO FSS operations. The Companies nevertheless caution the Commission to protect earlier entrants and therefore oppose the application of ITU date-priority to avoid in-line interference. The record also shows resounding support for amending the Commission's default sharing rules and for removing the global coverage requirement to promote efficient spectrum use and flexibility in satellite system design.

Finally, the Commission should modify its operational milestone proposal. Certainty and predictability for satellite investors is crucial and the best way to achieve these important goals in the milestone context is to apply clear, quantitative criteria to all NGSO FSS operators and types of constellations. Specifically, the Companies propose that the Commission require that thirty-three percent of the proposed constellation be launched and operational at the six-year mark and that seventy-five percent of the proposed constellation be launched and operational at the nine-year mark. The consequences of failing to meet these benchmarks could include bond forfeiture

or a reduction in the number of satellites the operator is allowed to launch and operate. By adopting the Companies' milestone proposal, the Commission can ensure that NGSO FSS systems of all sizes are shouldering an equal share of the burdens associated with successful co-existence and that valuable spectrum resources are not wasted.

The modifications proposed or supported by the Companies in this proceeding will allow the Commission to increase FSS access to spectrum while striking the right balance between promoting certainty and increasing flexibility for both NGSO and GSO FSS operators. The Commission should embrace this opportunity to adopt the proposals so strongly supported by the satellite community.

**Before the
Federal Communications Commission
Washington, D.C. 20554**

In the Matter of)	
)	
Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters)	IB Docket No. 16-408
)	

REPLY COMMENTS OF SES S.A. AND O3B LIMITED

SES S.A. (“SES”) and its subsidiary O3b Limited (“O3b”) (together, “the Companies”) submit these Reply Comments in response to the Federal Communications Commission’s (“Commission’s”) proposals in the Notice of Proposed Rulemaking (“NPRM”)¹ in the above-captioned proceeding. In the NPRM, the Commission proposes to add fixed-satellite service (“FSS”) allocations in the Ka-band and update certain rules governing the operation of FSS space stations to enable greater licensing flexibility, as described below.

SES and O3b have made meaningful contributions to the non-geostationary satellite orbit (“NGSO”) and geostationary satellite orbit (“GSO”) FSS environments by providing broadband services in established, underserved, and unserved markets.² Based on this experience, the Companies support many of the Commission’s proposals, which will allow expanded access to

¹ *In the Matter of Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters*, Notice of Proposed Rulemaking, 31 FCC Rcd 13651 (Dec. 15, 2016) (“NPRM”).

² See SES S.A. and O3b Limited, Comments, IB Docket No. 16-408, at 3-9 (filed Feb. 27, 2017) (“SES/O3b Comments”); The Satellite Industry Association, Comments, IB Docket No. 16-408, at 2-3 (filed Feb. 27, 2017) (“SIA Comments”) (“SIA member O3b . . . deployed a Ka-band NGSO system that began operations in 2013 and is already taking steps to significantly increase capacity to accommodate growing customer demand for high-throughput, high-performance connectivity.”).

valuable spectrum resources for FSS operators and promote the continued growth and development of next-generation satellite services. In this context, the proposals supported or proposed by the combined SES, a GSO FSS operator, and O3b, a NGSO FSS operator, uniquely balance the interests of both GSO and NGSO FSS operators.

I. THE SATELLITE INDUSTRY SUPPORTS THE EXPANSION OF SPECTRUM ACCESS FOR FSS SATELLITES IN THE KA-BAND.

As discussed below, the record shows strong support for the Commission's goal of expanding FSS operations in the Ka-band and promoting more flexible use of Ka-band spectrum by reinstating certain FSS use of the 17.8-20.2 GHz band and allowing new FSS operations in the 19.3-19.4 GHz, 19.6-19.7 GHz, and 29.3-29.5 GHz bands. Commenters also support further expanding FSS use by granting access to the 19.4-19.6 GHz band for GSO and NGSO FSS, granting access to the 29.1-29.25 GHz band for GSO FSS,³ and granting access to the 29.1-29.3 GHz band for NGSO FSS.

A. Revisions to the Ka-Band Plan

17.8-18.3 GHz. The satellite community generally supports the Commission's initiative⁴ to authorize FSS downlinks in the 17.8-18.3 GHz band. A majority of the parties commenting on this issue, including the Companies, agree that FSS downlinks in the 17.8-18.3 GHz band should be authorized subject to power flux density ("PFD") limits established by the

³ GSO FSS systems currently have co-primary, blanket authority in the 29.25-29.5 GHz band. *See Rulemaking to Amend Parts 1, 2, 21, and 25 of the Commission's Rules to Redesignate the 27.5-29.5 GHz Frequency Band, to Reallocate the 29.5-30.0 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services*, Third Report and Order, 12 FCC Rcd 22310, 22326-27 ¶¶ 40-41 (1997).

⁴ *See* NPRM ¶ 9.

International Telecommunication Union (“ITU”).⁵ These limits have already been adopted domestically to protect terrestrial fixed service (“FS”) operations⁶ in the adjacent frequency bands.⁷ Accordingly, the Commission should adopt its proposal to allow FSS operations in the 17.8-18.3 GHz band.

Despite widespread support for the Commission’s proposal to authorize FSS downlinks in the 17.8-18.3 GHz band, many parties, including the Companies, believe the Commission’s proposals do not go far enough. As discussed below, parties propose: (1) adopting co-primary status for individually licensed FSS earth stations; and (2) allowing secondary FSS operations under a blanket licensing regime.

1. Co-primary FSS Operations for Individually Licensed Earth Stations

Many commenters—including the Companies⁸—urge the Commission to allow individually licensed FSS earth stations to operate on a co-primary basis with the FS in the 17.8-

⁵ NPRM ¶ 9 & n.26 (citing PFD limits set forth in Article 21, Table 21-4 of the ITU Radio Regulations). See SES/O3b Comments at 10-13; Inmarsat Inc., Comments, IB Docket No. 16-408, at 1-2 (filed Feb. 27, 2017) (“Inmarsat Comments”); LeoSat MA, Inc., Comments, IB Docket No. 16-408, at 4 (filed Feb. 27, 2017) (“LeoSat Comments”); Lockheed Martin, Comments, IB Docket No. 16-408, at 2 (filed Feb. 27, 2017) (“Lockheed Martin Comments”); SIA Comments at 4-5; Space Norway AS, Comments, IB Docket No. 16-408, at 2-3 (filed Feb. 27, 2017) (“Space Norway Comments”); Telesat Canada, Comments, IB Docket No. 16-408, at 5 (filed Feb. 27, 2017) (“Telesat Comments”); ViaSat, Inc., Comments, IB Docket No. 16-408, at 7 (filed Feb. 27, 2017) (“ViaSat Comments”); WorldVu Satellites Ltd d/b/a/ OneWeb, Comments, IB Docket No. 16-408, at 29-30 (filed Feb. 27, 2017) (“OneWeb Comments”).

⁶ NPRM ¶ 9 & n.26.

⁷ See 47 C.F.R. § 25.208(c) (identifying the same PFD limits for the 17.7-17.8 GHz and 18.3-18.8 GHz bands).

⁸ The Companies propose amendments to NGXX2 that reflect this recommendation. Compare NPRM, Appendix A, with Attachment A to SES/O3b Comments.

18.3 GHz band.⁹ The Commission itself has recognized that earth stations are “critical link[s] between satellites and terrestrial networks,”¹⁰ and limiting operations to secondary status could be too restrictive. Allowing individually licensed earth stations to operate on a co-primary basis with regard to FS in this band “will allow satellite operators to ensure protection and long-term use of vital ground facilities without materially impacting FS use of the spectrum.”¹¹

2. Secondary FSS Operations Under a Blanket Licensing Regime

The Companies and many other commenters also recommend that the Commission authorize blanket licensed receive-only FSS terminals on a secondary basis with respect to FS in the 17.8-18.3 GHz band,¹² and not limit secondary operations to individually licensed earth stations.¹³ As LeoSat explained, “earth stations of FSS systems operate exclusively in receive

⁹ See Intelsat Comments at 2; LeoSat Comments at 4; Inmarsat Comments at 3. Cf. OneWeb Comments at 30 (OneWeb supports allowing NGSO FSS gateway earth stations to be co-primary with FS and states that coordination with a small number of gateway earth stations “should not present a coordination obstacle nor will it serve as a potential source of interference to terrestrial operations”). The Companies support allowing co-primary operations in this band with individually licensed earth stations, including gateway earth stations.

¹⁰ *2000 Biennial Regulatory Review -- Streamlining & Other Revisions of Part 25 of the Commission's Rules Governing the Licensing of, & Spectrum Usage by, Satellite Network Earth Stations & Space Stations*, Fifth Report and Order, 20 FCC Rcd 5666, 5670 ¶ 8 (2005).

¹¹ Inmarsat Comments at 3.

¹² See SES/O3b Comments at 11-12; Inmarsat Comments at 3; LeoSat Comments at 4; The Boeing Company, Comments, IB Docket No. 16-408, at 3-4 (filed Feb. 27, 2017) (“Boeing Comments”); OneWeb Comments at 30; see also ViaSat Comments at 7-8 (opposing proposal to limit operations in the band “to any particular type of earth station” or to individually-licensed earth stations). Cf. Space Exploration Technologies Corp., Comments, IB Docket No. 16-408, at 4 (filed Feb. 27, 2017) (“SpaceX Comments”) (“[A]ssuming an appropriate adjustment to the flawed PFD regime and the ability to deploy earth stations on a blanket-licensed basis, SpaceX supports these proposals.”). To be clear, O3b and SES do not support SpaceX’s suggested amendments to the PFD limits proposed by the Commission. See SpaceX Comments at 3-4, 7-13.

¹³ The Companies propose amendments to NGXX2 that reflect this recommendation. Compare NPRM, Appendix A, with Attachment A to SES/O3b Comments.

mode in this band.”¹⁴ Therefore, they are unable to cause interference to FS operations.¹⁵ Further, “such FSS earth stations may be operated without interference protection from FS operations because only a fraction of the 17.8-18.3 GHz band is likely to be used by FS on a local basis, leaving the rest of the spectrum available for FSS reception.”¹⁶ Therefore, in order to achieve the efficient use of spectrum and the flexibility that the Commission sought in the NPRM, FSS operators should be allowed to operate any type of blanket licensed receive-only terminal they deem suitable for operating on a secondary basis in the 17.8-18.3 GHz band.

In this vein, the Companies oppose limiting secondary operations in the band to gateway earth stations.¹⁷ The Companies also oppose Space Norway’s proposal to permit the ubiquitous deployment of NGSO FSS user terminals that communicate only with satellites in highly elliptical orbits (“HEOs”) in the 17.8-18.3 GHz band.¹⁸ PFD limits are sufficient to protect FS

¹⁴ LeoSat Comments at 4.

¹⁵ *See id.*; *see also* OneWeb Comments at 30 (“NGSO FSS systems have been authorized to operate in these spectrum bands via waiver, and have done so successfully, without interference to terrestrial or GSO operations. The ITU’s PFD limits have proven sufficient to protect terrestrial operators in bands that are shared (below 19.7 GHz) where such limits were adopted with significant input from U.S. terrestrial operators.”).

¹⁶ LeoSat Comments at 5.

¹⁷ *Cf.* OneWeb Comments at 29, 30 (agreeing with the Commission that “NGSO FSS operations should be secondary to fixed terrestrial operations in the 17.8-18.3 GHz band insofar as NGSO operators seek to use this frequency band to operate blanket-licensed earth stations (such as user terminals)”). OneWeb also argues that the Commission should “permit NGSO FSS operators to open additional gateway channels, facilitating stronger and higher-capacity connections between NGSO satellites and gateway earth stations” in the 17.8-18.3, 18.3-18.6, and 19.7-20.2 GHz bands. OneWeb Comments at 29. As OneWeb states, “access to a sufficient amount of gateway spectrum is critical to ensuring that NGSO satellite constellations can provide high-quality, high-speed broadband access to large, previously unserved or underserved populations.” OneWeb Comments at 31.

¹⁸ *See* Space Norway Comments at 2-3 (“[B]ecause: (i) [ITU-R Regulation 147] PFD limits will protect terrestrial services from harmful interference from HIO systems, and (ii) all NGSO FSS user terminals will operate on [an unprotected, non-interference] basis, terrestrial operators will

operations from interference from all FSS operations, not just those operating in HEO.¹⁹

18.3-18.6 GHz and 19.7-20.2 GHz. The satellite community also generally agrees with the Commission's proposal to allow NGSO FSS systems to operate in the 18.3-18.6 GHz and 19.7-20.2 GHz bands on the condition that they do not cause unacceptable interference to, or claim protection from, GSO FSS networks,²⁰ subject to single-entry and aggregate limits on equivalent power flux-density ("EPFD").²¹ In fact, not a single commenter explicitly opposes the Commission's proposals.²² The Commission's proposals with respect to the 18.3-18.6 GHz and 19.7-20.2 GHz bands would "codify existing practices" and "provide greater regulatory

not be materially burdened by allowing ubiquitous deployment of NGSO FSS user terminals for HIO systems operating in the 17.8-18.3 GHz band."). This subset of HEO systems to which Space Norway refers is known as highly inclined orbits ("HIOs"). *See id.* at 2.

¹⁹ *See infra* Section III.A.

²⁰ *See, e.g.,* SES/O3b Comments at 13; Lockheed Martin Comments at 2; Boeing Comments at 4; Inmarsat Comments at 4; LeoSat Comments at 6; SIA Comments at 5; Space Norway at 3; SpaceX Comments at 5; Telesat Comments at 16.

²¹ *See, e.g.,* SES/O3b Comments at 13; Lockheed Martin Comments at 2; Space Norway at 3; SpaceX Comments at 5; LeoSat Comments at 6 (suggesting that EPFD limits be tied to the Commission's proposed text for Section 25.146(c) and that compliance with the limits be assessed using the most recent version of ITU-R Recommendation S.1503). The Companies agree that it is important to adopt a mechanism for ensuring that aggregate EPFD limits are met, as proposed by Inmarsat. *See* Inmarsat Comments at 4, 8-9. In addition, with regard to ITU-R Recommendation S.1503 and as indicated in the Companies' Comments, the proposed ITU software does not adequately model the O3b system. The Companies are actively engaged in the development of possible revisions to Recommendation ITU-R S.1503 currently ongoing at the ITU to improve the Recommendation and the underlying software, and request that the Commission continue to work within the ITU to ensure its software can accurately assess a variety of NGSO FSS system designs. In the meantime, the Companies request that the Commission consider alternative means for NGSO FSS operators to demonstrate compliance with EPFD limits that can be validated by potentially affected parties.

²² *But see* ViaSat Comments at 11 (recommending that the Commission "carefully examine the impact that operating environment may have on the prospects of NGSO-GSO sharing before simply codifying the *ad hoc* practice developed to allow one particular type of NGSO FSS constellation to operate on an unprotected basis with respect to GSO FSS networks in those band segments").

certainty on matters already deemed consistent with the public interest.”²³

18.8-19.3 GHz and 28.6-29.1 GHz. Many of the commenters that addressed the Commission’s proposals for the 18.8-19.3 GHz band generally agree with the Commission’s proposal to allow GSO FSS operations in the 18.8-19.3 GHz band on the condition that they do not cause harmful interference to, or claim protection from, NGSO FSS systems.²⁴ Adopting this proposal would be consistent with International Bureau waivers and the current secondary GSO FSS designation in the paired 28.6-29.1 GHz band.²⁵

However, several parties, including the Companies, oppose the Commission’s alternative proposal to allow GSO FSS operations on a co-primary basis with NGSO FSS operations in the 18.8-19.3 GHz or the 28.6-29.1 GHz bands.²⁶ Arguments to the contrary, such as those raised by

²³ Lockheed Martin Comments at 2. *Cf.* Boeing Comments at 4 (noting the Commission has already “successfully allowed” other NGSO FSS systems to use all or portions of the 18.3-18.6 and 19.7-20.2 GHz bands); LeoSat Comments at 6; OneWeb Comments at 30.

²⁴ *See* NPRM ¶ 11, Appendix A, Appendix C (proposed footnote NG165). *See, e.g.,* SES/O3b Comments at 13; Space Norway Comments at 3-4; SpaceX Comments at 5; OneWeb Comments at 16. *See also* Boeing Comments at 5 (“Boeing does not object to allowing GSO FSS operations in the 18.8-19.3 GHz downlink band on an unprotected, non-interference basis with respect to NGSO FSS systems and paired with the current secondary GSO FSS designation in the 28.6-29.1 GHz band.”); Kepler Communications Inc., Comments, IB Docket No. 16-408, at 1 (filed Feb. 27, 2017) (“Kepler Comments”) (supporting codification of Ka-band plan policies allowed through the use of waivers). The Companies and OneWeb also support the new footnote NG165, which mandates that GSO FSS operations shall not cause harmful interference to, or claim protection from, NGSO FSS systems in the 18.8-19.3 GHz and 28.6-29.1 GHz bands. *See* NPRM, Appendix A; SES/O3b Comments, Attachment A; OneWeb Comments at 19.

²⁵ *See* SES/O3b Comments at 13; Space Norway Comments at 3; OneWeb Comments Summary at 2.

²⁶ *See* Boeing Comments at 5 (because GSO FSS systems have priority over NGSO FSS in “the vast majority of frequency bands allocated to FSS” it is “important to preserve some FSS frequency bands as having priority for NGSO systems”); *see also* Space Norway Comments at 4; SpaceX Comments at 5-6 (a co-primary GSO FSS allocation “would present significant coordination issues, since there are no EPFD limits in these bands”); OneWeb Comments at 2, 16, 17.

EchoStar/Hughes (“EchoStar”) in support of the Commission’s alternative proposal, ignore the detrimental consequences that allowing co-primary operations would have on existing and proposed NGSO FSS systems in the United States.²⁷

EchoStar attempts to downplay O3b’s significant activity in the bands by focusing on the years preceding O3b’s launch. Much has changed since then. O3b successfully launched its first four satellites in 2013 and, since that time, has become the fastest growing satellite operator in history.²⁸ Today, O3b serves over 50 customers in more than 36 countries.²⁹ In fact, after less than three years in service, O3b already needs to substantially increase its network capacity to meet the growing demand for its high-throughput, low-latency services.³⁰ Further, although O3b is currently the only operational NGSO FSS system in these bands, many other NGSO FSS operators have filed applications seeking access for their innovative systems.³¹ These applicants have worked for years to develop their systems and secure the investment necessary to support their future operations. To be successful, these NGSO FSS operations require NGSO FSS

²⁷ See EchoStar Satellite Operating Corp. and Hughes Network Systems, LLC, Comments, IB Docket No. 16-408, at 3-7 (filed Feb. 27, 2017).

²⁸ See SES/O3b Comments at 8 n.31.

²⁹ O3b has gained customers and expanded its service to five additional countries since last publishing its coverage statistics. Cf. SES/O3b Comments at 8 n.31; *see also generally* SES/O3b Comments at 4-8.

³⁰ See SES/O3b Comments at 8 & n.31.

³¹ See, e.g., Boeing Application, SAT-LOA-20161115-00109 (filed Nov. 15, 2016); Kepler Communications Application, SAT-LOI-20161115-00114 (filed Nov. 15, 2016); SpaceX Application, SAT-LOA-20161115-00118 (filed Nov. 15, 2016); O3b Application, SAT-AMD-20161115-00116 (filed Nov. 15, 2016); Audacy Corp. Application, SAT-LOA-20161115-00117 (filed Nov. 15, 2016); Theia Holdings A, Inc. Application, SAT-LOA-20161115-00121 (filed Nov. 15, 2016); Telesat Application, SAT-LOI-20161115-00108 (filed Nov. 15, 2016); Space Norway Application, SAT-LOI-20161115-00111 (filed Nov. 15, 2016); LeoSat Application, SAT-LOI-20161115-00112 (filed Nov. 15, 2016); ViaSat Application, SAT-LOI-20161115-00120 (filed Nov. 15, 2016); and Karousel LLC Application, SAT-LOA-20161115-00113 (filed Nov. 15, 2016).

systems to have sole priority in at least some spectrum band segments in the United States.³²

Adopting the Commission's alternative proposal for this band "would undermine settled expectations of NGSO operators by depriving them of the only two bands where they have sole primary status."³³

19.3-19.4 GHz, 19.6-19.7 GHz, and 29.3-29.5 GHz. A significant number of commenters generally support the Commission's proposals to grant FSS access to the 19.3-19.4 GHz, 19.6-19.7 GHz, and 29.3-29.5 GHz bands on a co-primary basis with FS,³⁴ which will put underutilized spectrum to more extensive use.³⁵ Furthermore, NGSO FSS systems can successfully operate on a secondary basis with respect to GSO FSS networks in these bands. Inmarsat "questions the usefulness" of allowing NGSO FSS operations in the 29.3-29.5 GHz

³² Cf. Space Norway Comments at 4 ("Space Norway strongly believes that the primary status of NGSO systems should be maintained in those bands in which this status already exists to provide NGSO operators maximum flexibility in choosing their system characteristics, particularly with respect to geographical areas of operation and deployment of small, ubiquitous user terminals.").

³³ SpaceX Comments at 5. GSO FSS systems have operational priority over NGSO FSS systems in the vast majority of the frequency bands allocated to FSS in the United States. See 47 C.F.R. § 25.202(a)(1); see also Boeing Comments at 5.

³⁴ See, e.g., SES/O3b Comments at 14; Intelsat Comments at 2; LeoSat Comments at 6-7; Lockheed Martin Comments at 2; ViaSat Comments at 9. Cf. Boeing Comments at 6 (supports authorizing the FSS to operate in the 19.3-19.4 GHz, 19.6-19.7 GHz, and 29.3-29.5 GHz bands but argues that NGSO FSS systems should have priority over GSO FSS systems in these band segments); Inmarsat Comments at 5-6 (supports authorizing GSO FSS operations on a primary basis in the 19.3-19.4 GHz and 19.6-19.7 GHz bands and does not object to NGSO FSS secondary operations as discussed in paragraph 13 of the NPRM, but opposes the addition of NGSO FSS on a secondary basis in the 29.3-29.5 GHz band); Space Norway Comments at 4-5 (Space Norway "supports the inclusion of these new FSS allocations" but suggests giving NGSO and GSO systems equal status is more appropriate). GSO FSS operations currently have co-primary, blanket authority with respect to NGSO MSS in the 29.25-29.5 GHz band. See *supra* note 3.

³⁵ See SES/O3b Comments at 14; Boeing Comments at 6; ViaSat Comments at 9; Inmarsat Comments at 5; see also NPRM ¶ 13.

band,³⁶ given that the allocation would not apply to NGSO FSS service abroad.³⁷ However, the answer is that allowing secondary NGSO FSS operations in this band under the Commission's rules would increase access to spectrum for the growing number of NGSO FSS operators seeking to provide service in the United States, which would represent a tremendous benefit to U.S. businesses and consumers.

Several commenters, including Inmarsat and LeoSat,³⁸ further agree that the Commission should, as the Companies propose,³⁹ allow the operation of individually licensed FSS earth stations (GSO and NGSO) in the 19.3-19.4 GHz and 19.6-19.7 GHz bands, on a first-come, first-served basis and coordinated with terrestrial stations, without restricting FSS operators' ability to also deploy other types of earth stations on a secondary basis.⁴⁰

Furthermore, the Companies do not support proposals to elevate NGSO FSS operations in the 19.3-19.4 GHz, 19.6-19.7 GHz, or 29.3-29.5 GHz bands (other than those for MSS feeder-links) so that such NGSO FSS operations are equal to, or superior to, GSO FSS operations in the same bands.⁴¹ The 29.25-29.5 GHz band has been a long-standing GSO blanket-licensed band,

³⁶ See Inmarsat Comments at 6.

³⁷ NGSO FSS operations would still be limited to feeder links for GSO FSS systems and NGSO MSS feeder links outside of the United States under RR No. 5.535A.

³⁸ See LeoSat Comments at 7; Inmarsat Comments at 7.

³⁹ The Companies propose amendments to NGXX2 that reflect this recommendation. See SES/O3b Comments at 14; compare NPRM, Appendix A, with Attachment A to SES/O3b Comments.

⁴⁰ Cf. LeoSat Comments at 7 (explaining "blanket-licensed receive earth stations could be deployed in the NGSO FSS allocation in the 19.3-19.4 GHz and 19.6-19.7 GHz bands on a non-interference basis with respect to FS operations. . . . [T]hese earth stations would not cause any operational burden to FS operations because they would operate in receive mode in this band and therefore cannot interfere with FS stations.").

⁴¹ See Space Norway Comments at 4-5 (supporting "[e]qual status among NGSO and GSO systems" in the 19.3-19.4 GHz, 19.6-19.7 GHz, and 29.3-29.5 GHz bands); Boeing Comments at

and GSO operations there should not be disrupted by introducing NGSO operations on a co-primary basis with GSO operations, or by relegating GSO operations to secondary status.

Further, Iridium itself does not oppose the Commission's proposals for the 19.3-19.4 GHz, 19.6-19.7 GHz, and 29.3-29.5 GHz band segments.⁴²

19.4-19.6 GHz and 29.1-29.3 GHz. A number of satellite operators, including the Companies, ask that the Commission also allow greater NGSO and GSO FSS access to the 19.4-19.6 GHz and 29.1-29.25 GHz bands, and greater NGSO FSS access to the 29.25-29.3 GHz band.⁴³ These spectrum bands are currently "underutilized, to the detriment of the public."⁴⁴ The Companies agree with ViaSat that the Commission's proposals for the 19.3-19.4 GHz, 19.6-19.7 GHz, and 29.3-29.5 GHz band segments "do not go far enough," given that the 19.4-19.6 GHz and 29.1-29.25 GHz band segments are only used by Iridium and "otherwise are largely fallow."⁴⁵

6-7 (urging the Commission to "designate NGSO FSS as having priority over GSO FSS" in the 19.3-19.4 GHz, 19.6-19.7 GHz, AND 29.3-29.5 GHz bands).

⁴² Iridium Satellite LLC, Comments, IB Docket No. 16-408, at 3 (Feb. 27, 2017) ("Iridium recognizes the requirements for more intensive use of spectrum that are driving the Commission to make its proposal for the 19 GHz and 29 GHz Sub-bands. For this reason, Iridium is not opposing the proposal" but asks the Commission to "balance those requirements against the increasing pressures Iridium is facing in the Iridium Feeder Link Bands" (19.4-19.6 GHz and 29.1-29.3 GHz)).

⁴³ See SES/O3b Comments at 14-15; Intelsat Comments at 3 (the Commission "should consider making the 19.4-19.6 GHz and 29.1-29.25 GHz bands available to GSO FSS operators provided, and subject to the condition that, the GSO operator successfully coordinates" with Iridium); ViaSat Comments at 9-10. See also *supra* note 3.

⁴⁴ ViaSat Comments at 9. See also SES/O3b Comments at 15.

⁴⁵ ViaSat Comments at 9.

Increased access could be readily achieved by allowing FSS access to the available, opposite polarization from that used by Iridium, as proposed by the Companies.⁴⁶ Further, with regard to the spectrum and polarization used by Iridium, the Commission should grant access through coordination with Iridium. GSO FSS operators currently share and successfully coordinate with Iridium in of the 29.25-29.3 GHz band, and that same process can be used in the 19.4-19.6 GHz and 29.1-29.25 GHz bands.⁴⁷ In order to improve the coordination process, coordination zones could be defined.⁴⁸ Operations within the zones would require coordination with Iridium, but operations beyond the defined zones would not require coordination. The Companies note that Iridium's NGSO MSS feeder link stations are limited in number, making it feasible to coordinate shared use of the bands with FSS operators.⁴⁹ The Commission should take this opportunity to "allow this spectrum to be used more efficiently" by increasing FSS access to these bands.⁵⁰

⁴⁶ See SES/O3b Comments at 15.

⁴⁷ Cf. ViaSat Comments at 10 ("Because Iridium's NGSO MSS feeder link stations are limited in number, it should be relatively easy to coordinate shared use of the band with FSS operators. Indeed, the Commission has previously authorized another GSO FSS operator to use this spectrum after concluding that doing so would not create a risk of harmful interference into Iridium's operations.").

⁴⁸ See, e.g., Recommendation ITU-R S.1419 Annex 1 § 3 (recommending a geographic isolation of between 60 km and greater than 225 km to reduce interference to acceptable levels).

⁴⁹ See, e.g., ViaSat Comments at 10.

⁵⁰ *Id.* at 9-10. ViaSat notes that the Commission "anticipated that multiple satellite systems would operate [in the 19.4-19.6 and 29.1-29.25 GHz bands] on a shared basis" when it designated them for NGSO MSS use. See *id.* at 10. Intelsat similarly supports GSO FSS operations in the bands, subject to successful coordination with Iridium. See Intelsat Comments at 3. The Commission should not heed Inmarsat's arguments against allowing NGSO FSS access to the 29.1-29.3 GHz band. See Inmarsat Comments at 6 (Inmarsat cautions against allowing expanded NGSO FSS access to the 29.1-29.5 GHz band because ITU RR 5.535A restricts the use of the band to GSO FSS systems and feeder links to NGSO MSS). See *supra* notes 44-46 and accompanying text.

The Companies do not support LeoSat’s proposal to grandfather Iridium’s operations in the 19.4-19.6 GHz band so that they are considered “super-primary” or provided other special protection.⁵¹ Adopting this proposal would hinder the ability of other FSS operators to use this band and would be contrary to the Commission’s goal to facilitate increased access to spectrum for new FSS operations.⁵²

B. Codification

Along with the Companies, parties generally support the Commission’s proposal to codify its existing practices to create a more predictable licensing and operating environment for both existing and future FSS operators.⁵³ Among the parties addressing the issue, the Commission received widespread support for its proposal to “codify the Ka-band Plan’s satellite designations into footnotes to the U.S. Table of Frequency Allocations.”⁵⁴

Parties addressing the issue were also aligned in their opposition to the Commission’s proposal to remove from Section 25.202(a)(1) the list of frequency bands available for FSS.⁵⁵ While these designations are also contained in the Table of Allocations, it is very useful for the satellite industry to have Section 25.202(a)(1) also contain the information from “the Table of Allocations regarding available satellite frequencies and relevant band-specific restrictions in a

⁵¹ *Cf.* LeoSat Comments at 7.

⁵² *See* NPRM ¶¶ 1-2, 8.

⁵³ *See* SES/O3b Comments at 16; *see, e.g.*, Space Norway Comments at 5; SpaceX Comments at 6; SIA Comments at 6. *Cf.* ViaSat Comments at 6-7.

⁵⁴ NPRM ¶ 14. *See, e.g.*, SES/O3b Comments at 16; SIA Comments at 6; Space Norway Comments at 6; SpaceX Comments at 6.

⁵⁵ *See* SIA Comments at 6-7; SpaceX Comments at 6; Boeing Comments at 7.

single location for ease of reference.”⁵⁶ As SpaceX explains, “[a]nyone interested in designing an FSS system or evaluating FSS opportunities would have a much easier time doing so with the benefit of a list like that . . . rather than hunting through the table of allocations in search of relevant spectrum.”⁵⁷ The Companies agree.

A number of parties commenting on this issue, including the Companies, also support the Commission’s proposal to modify the language in note 6 of Section 25.202(a)(1) of the Commission’s rules to replace the term “gateway earth stations” with “individually-licensed earth stations” as proposed in the NPRM.⁵⁸

II. THE COMMISSION SHOULD AMEND THE DEFAULT SHARING RULES IN SECTION 25.156(d)(5).

Every party that addressed the Commission’s proposal with respect to Section 25.156(d)(5) supports the Commission’s proposed deletion of the first sentence of that rule.⁵⁹ Despite the current rule,⁶⁰ the Commission has authorized by waiver both GSO and NGSO FSS operations to much success,⁶¹ underscoring that the existing limitation is unnecessary and should

⁵⁶ SIA Comments at 6-7 (“SIA members find the enumeration of available bands in Section 25.202(a)(1) to be useful”).

⁵⁷ SpaceX Comments at 6.

⁵⁸ See SES/O3b Comments at 16; SIA Comments at 6. SpaceX does not object to the replacement term, but requests clarification that the use of the term should not affect the debate over whether to allow blanket licensed earth stations to operate in a given band, whether by waiver or by a future change in policy. See SpaceX Comments at 6.

⁵⁹ See Boeing Comments at iii, 10-12; Inmarsat Comments at 2, 9-10; SIA Comments at 8-9; Space Norway Comments at 9; OneWeb Comments at 20, 24-25.

⁶⁰ 47 C.F.R. § 25.156(d)(5).

⁶¹ See NPRM ¶ 21; SIA Comments at 8 (“[T]he Commission has not followed [Section 25.156(d)(5)] in the Ka-band spectrum but has instead authorized both GSO and NGSO operations, even though to date there are no formal rules for NGSO-GSO sharing in those frequencies. The proven success of co-frequency GSO and NGSO operations in the Ka-band demonstrates that the Section 25.156(d)(5) framework is not necessary to enable sharing.”).

be removed.⁶²

Furthermore, the majority of commenters addressing this issue urge the Commission to go a step further and remove Section 25.156(d)(5) in its entirety.⁶³ GSO and NGSO FSS systems have proven that sharing is feasible without the need for the current default rules.⁶⁴ The Commission should remove its overly conservative licensing approach prior to implementing sharing rules, and instead implement the approach described in No. 22.2 of the ITU Radio Regulations.⁶⁵

III. TECHNICAL ISSUES.

The Companies and a significant number of commenters support many of the technical proposals made by the Commission and agree that these proposals will further the Commission's goal of successfully expanding FSS operations in the Ka-band while promoting more flexible use of spectrum resources. However, the Companies, along with many other parties participating in this proceeding, object to certain of these technical proposals and recommend modifications to several others, as discussed below.

⁶² See, e.g., SIA Comments at 8; Boeing Comments at 11 ("It is now clear that GSO and NGSO systems can share spectrum on a co-frequency basis using various techniques. Therefore, a prohibition on their joint operation is unnecessary."); OneWeb Comments at 2 ("[A]bsent established sharing criteria, modern technologies allow NGSO operations to coexist with GSO operations on a non-interference basis.").

⁶³ See Inmarsat Comments at 9-10; SIA Comments at 8-9; OneWeb Comments at 20, 24-25.

⁶⁴ See, e.g., SIA Comments at 8-9 ("The Commission's experience with Ka-band spectrum demonstrates that sharing between NGSO and GSO systems is feasible even if the Commission has not yet adopted sharing rules, and that dividing the spectrum up among applicants is simply unnecessary. As a result, SIA urges the Commission to delete both sentences of Section 25.156(d)(5).").

⁶⁵ See Inmarsat Comments at 9-10; OneWeb Comments at 24.

A. Power Limits to Protect Terrestrial Operations

Many commenters, including the Companies, agree that ITU-adopted PFD limits for FSS operations are sufficient to protect primary FS operations in the 17.8-18.3 GHz band without requiring coordination.⁶⁶ These PFD limits were developed through a multi-stakeholder process with input from terrestrial system operators in the United States, evidencing approval of these limits as appropriate to protect FS systems.⁶⁷

Accordingly, the Companies do not support Telesat's proposal to adopt EPFD limits for NGSO FSS systems in the 17.8-18.6 GHz and 18.8-19.7 GHz bands to protect terrestrial stations.⁶⁸ First, as several parties recognize, it is difficult to determine and validate the EPFD limits required to protect terrestrial stations.⁶⁹ Second, adopting such limits would be inconsistent with ITU rules on preventing interference since there is no international EPFD standard for this purpose.⁷⁰ Finally, the Commission would have to undertake an extensive

⁶⁶ See, e.g., Boeing Comments at 2-3 ("Given the highly directional nature of the FS antennas in this frequency band, sufficient sidelobe isolation, typically in excess of 28 to 30 dB, would be available to ensure that FS links operating co-frequency in the 17.8-18.3 GHz band with NGSO downlinks at the authorized PFD limits would experience very limited and transient interference impacts relative to their operational noise floor."); LeoSat Comments at 8; Lockheed Martin Comments at 2; Space Norway Comments at 2-3; OneWeb Comments at 20.

⁶⁷ See, e.g., NPRM ¶ 9; Space Norway Comments at 3; OneWeb Comments at 20; SIA Comments at 5.

⁶⁸ Cf. Telesat Comments at 5; see also Boeing Comments at 8 (noting its intent to comply with Section 25.208(e) PFD limits, but "nevertheless" supporting the development of EPFD limits for NGSO FSS operations).

⁶⁹ See, e.g., OneWeb Comments Summary at 2. Cf. SpaceX Comments at 7 ("SpaceX supports [applying ITU-adopted PFD limits to the 17.8-18.6 GHz and 18.8-19.7 GHz bands] in concept, as specifying a PFD limit will simplify the showing necessary to ensure that an NGSO system is compatible with FS operations throughout this band."). To be clear, the Companies do not support SpaceX's proposal to apply an aggregate PFD limit to these bands. Cf. SpaceX Comments at 8.

⁷⁰ See OneWeb Comments at 20-21.

notice and comment process, with input from stakeholders across the satellite industry, to determine the appropriate EPFD limits. This would create unnecessary uncertainty and delay the commencement of satellite operations in these bands.⁷¹

The Companies support adopting a PFD limit that only considers satellites visible to the potentially affected terrestrial station, which is a more efficient and effective approach. By contrast, extending the specific limits in Section 25.208(e) would perpetuate a “well-known technical flaw in the rule”⁷² as applied to larger constellations because the methodology used to calculate interference captures all satellites in the NGSO system, without considering whether the satellites are actually in view of the “victim” terrestrial system or whether the satellites are transmitting or not.⁷³ Only those satellites in view and in operation would actually contribute to potential interference at a given point on the earth.⁷⁴ Thus, applying the aggregate PFD limit established in Section 25.208(e) would over-estimate the potential for interference to FS systems,⁷⁵ and may also fail to protect FS stations in other circumstances,⁷⁶ all while significantly and unnecessarily constraining the design and performance of NGSO FSS constellations.⁷⁷

Many parties, including the Companies, do not support the Commission’s interim

⁷¹ *Contra* Telesat Comments at 5; Boeing Comments at 8.

⁷² SpaceX Comments at ii.

⁷³ *See id.*; *see also id.* at 8-10.

⁷⁴ *See id.* at 9-10.

⁷⁵ *See id.*

⁷⁶ *See* OneWeb Comments at 21-22.

⁷⁷ *See* Boeing Comments at 8-9 (“Creating a *de facto* limit on the aggregate PFD of a NGSO constellation will unnecessarily limit the broadband service and terminal sizes available from even a single NGSO FSS satellite and significantly constrain the design and/or performance of the entire constellation.”).

proposal to impose an aggregate PFD limit of $-115 \text{ (dBW/m}^2\text{)/MHz}$ to protect terrestrial systems.⁷⁸ This proposal is too restrictive and does not appear to be supported by a technical analysis demonstrating that this approach would protect terrestrial systems at low elevation angles of zero to five degrees better than ITU-adopted PFD limits or the existing limits in Section 25.208(e) of the Commission's rules.

B. Power Limits to Protect GSO Operations

Many commenters, including the Companies, support applying ITU Article 22 EPFD limits to NGSO FSS operations in the bands that have historically included NGSO FSS operations, such as the 17.8-18.6 GHz, 19.7-20.2 GHz, 27.5-28.6 GHz, and 29.5-30 GHz bands.⁷⁹ The Companies and several other commenters also support the Commission's proposal to extend relevant EPFD limits to the bands in which NGSO FSS operations will be added as a result of this proceeding, including the 19.3-19.4 GHz, 19.6-19.7 GHz, and 29.3-29.5 GHz bands.⁸⁰ The Companies also propose applying the relevant EPFD limits to the 19.4-19.6 GHz and 29.1-29.3 GHz bands. However, as discussed above, several commenters—including the Companies—strongly oppose the Commission's proposal to add EPFD limits in bands that have

⁷⁸ See, e.g., Boeing Comments at ii, 8-9; see also SpaceX Comments at 11-12.

⁷⁹ See e.g., SES/O3b Comments at 19-21; SIA Comments at 5; Inmarsat Comments at 7-8; Kepler Comments at 2; LeoSat Comments at 6, 10; Space Norway at 8; Telesat Comments at 6; Boeing Comments at ii, 9. Cf. OneWeb Comments at 22-23 (supporting application of the ITU EPFD limits, if the Commission does not accept its primary proposal to adopt two sets of EPFD limits for each of the 17.8-18.6 GHz and 19.7-20.2 GHz bands). To be clear, the Companies do not support OneWeb's proposal to (1) adopt two sets of EPFD limits in both the 17.8-18.6 and 19.7-20.2 GHz bands or (2) allow the NGSO FSS licensee or grantee to meet either the single-entry limits of the 3G or 4G tables or the aggregate limits in the 3H or 4H tables. See OneWeb Comments at 23-24.

⁸⁰ See, e.g., SES/O3b Comments at 19-21; Kepler Comments at 2; Boeing Comments at 9; LeoSat Comments at 10; Space Norway Comments at 8.

historically been allocated to NGSO FSS operations on a primary basis in the United States, specifically the 18.8-19.3 GHz and 28.6-29.1 GHz bands.⁸¹

In addition, the Commission should reject calls to re-examine EPFD limits in the 17.8-18.6 GHz, 19.7-20.2 GHz, 27.5-28.6 GHz, and 29.5-30 GHz bands. Parties arguing that existing EPFD limits are inadequate as applied to NGSO FSS operations in these bands have provided no evidence to substantiate their claims.⁸² Even if there was a reason to re-examine these limits—and there is none—initiating this process at such a crucial point for NGSO FSS innovation and deployment would delay investment and innovation in the band.⁸³ Any re-examination of the EPFD limits would also have the effect of unsettling the NGSO FSS ecosystem, including current NGSO FSS applications demonstrating compliance with ITU rules. Especially in light of the Commission’s tentative conclusion that current EPFD limits “will be sufficient to protect GSO FSS networks from unacceptable interference,”⁸⁴ there is simply no reason to risk such a negative outcome.

C. Avoidance of In-line Interference

A significant number of commenters, including the Companies, support the

⁸¹ See *supra* Section I.A; OneWeb Comments at 16, 24 (“OneWeb does not support the adoption of EPFD limits in bands that are shared on a co-primary basis between GSO FSS and NGSO FSS internationally (18.8-19.7 GHz and 28.6-29.5 GHz.)”; see also SpaceX Comments at 5-6.

⁸² See, e.g., ViaSat Comments at i-ii, 12-18 (urging the Commission to re-examine the ITU EPFD limits to protect GSO networks from NGSO operations).

⁸³ See OneWeb Comments at 21 (urging the Commission to adopt ITU PFD limits and to “[p]ostpon[e] . . . a rule change” adopting EPFD limits instead of PFD limits until EPFD studies are complete in order to “add certainty to many current NGSO applications”); SpaceX Comments at 10-11 (noting that development of a new PFD or EPFD limits “could easily take several years” and cautioning the Commission not to suspend its consideration of pending NGSO FSS applications).

⁸⁴ See NPRM ¶¶ 10, 19.

Commission's proposals to apply default procedures set out in Section 25.261 to avoid in-line interference among NGSO FSS systems in the bands in which NGSO FSS operations are proposed.⁸⁵ Adoption of the modifications proposed by O3b and SES in their Comments is likewise supported by the record.

1. In-line Events Between Existing Systems

Commenters agree that the Commission's rules regarding in-line interference avoidance should be extended to apply to NGSO FSS systems that operate in the 17.8-18.6 GHz, 19.3-19.4 GHz, 19.6-20.2 GHz, 27.5-28.6 GHz, and 29.3-29.5 GHz bands, as proposed in the NPRM.⁸⁶ Similarly, the approach should apply in the additional bands proposed in the Companies' Comments, the 19.4-19.6 GHz and 29.1-29.3 GHz bands.⁸⁷ Expanding application of Section 25.261 is the "preferred spectrum sharing mechanism,"⁸⁸ given the Commission's decision to implement the same in-line interference avoidance mechanism in NGSO FSS license grants to date.⁸⁹ As many parties recognize, sharing among satellite systems is: (1) possible through coordination; (2) an efficient means of establishing a baseline for handling in-line events; and (3)

⁸⁵ See NPRM, Appendix A, § 25.261 (expanding the scope of the rule to also include the 17.8-18.6 GHz (space-to-Earth), 19.3-19.4 GHz (space-to-Earth), 19.6-20.2 GHz (space-to-Earth), 27.5-28.6 GHz (Earth-to-space), and 29.3-30 GHz (Earth-to-space) bands); SES/O3b Comments at 23-27; Boeing Comments at 12-13; LeoSat Comments at 11; Lockheed Martin Comments at 2-3; SpaceX Comments at 17-18; OneWeb Comments at 8-9.

⁸⁶ See NPRM ¶ 23; Boeing Comments at 12-13; LeoSat Comments at 11; Lockheed Martin Comments at 2; SpaceX Comments at 17-18; OneWeb Comments at 8-9.

⁸⁷ See SES/O3b Comments at 14-15, 23.

⁸⁸ OneWeb Comments at 10.

⁸⁹ See, e.g., OneWeb Comments at 10-11; SpaceX Comments at 16-18; see also SES/O3b Comments at 24. As Boeing asserts, the Commission should not "automatically require that different NGSO FSS systems sharing the same spectrum employ a band splitting approach to address an in-line conflict," but rather, the Commission's rules should "acknowledg[e] that NGSO FSS systems faced with in-line events can employ band splitting or other technical or operational means to address a sharing conflict." Boeing Comments at 13.

helps avoid the mishandling of spectrum resources that would occur through band segmentation.⁹⁰

While FSS operators generally have incentives to reach efficient coordination agreements, the Commission should adopt rules and policies that help promote fair spectrum sharing during in-line events.⁹¹ O3b and SES support analyzing spectrum sharing dynamics to help ensure that satellite operators bear a proportionate burden and only support band-splitting as a last resort.⁹²

The Companies oppose Boeing's proposal to identify avoidance criteria for each frequency band after every application.⁹³ This would create too much uncertainty for all FSS operators (NGSO and GSO) and is an inefficient use of resources. In this vein, the Companies also oppose Space Norway's proposal that HEO systems be treated differently than low-earth orbit ("LEO") and medium-earth orbit ("MEO") systems.⁹⁴ Space Norway argues that LEO and MEO systems should bear more responsibility for in-line interference avoidance between HEO and LEO/MEO systems and that mandatory coordination agreements should protect HEO systems.⁹⁵ The Commission should instead ensure that all NGSO FSS systems carry a coordination burden proportionate to the size of their constellations and should not adopt a rule

⁹⁰ See SES/O3b Comments at 24-25; *see also* SpaceX Comments at 18 (the in-line interference regime "offers the best methodology for intra-service spectrum sharing, and is much preferable to a simple spectrum splitting approach such as that in Section 25.157"); LeoSat Comments at 11.

⁹¹ As ViaSat explains, the Commission should "ensure that the burdens of spectrum sharing are equitably distributed among all NGSO systems." *See* ViaSat Comments at 20-21.

⁹² *See* SES/O3b Comments at 24-25.

⁹³ *See* Boeing Comments at 12-13.

⁹⁴ *See* Space Norway Comments at 9-12.

⁹⁵ *See* Space Norway Comments at 11.

unreasonably favoring HEO systems.

In-Line Event Trigger Angle. With respect to the trigger separation angle issue, nearly all commenters discussing the issue agree that a 10-degree separation angle is inappropriate. For example, Kepler and LeoSat support angular separations of less than ten degrees,⁹⁶ as the Companies proposed.⁹⁷ The current ten-degree separation threshold for co-frequency NGSO FSS space station operations was adopted in the early 2000s when there were fewer, much simpler constellations being proposed.⁹⁸ This default rule is outdated and inappropriate for today's NGSO FSS constellations.⁹⁹

Although Telesat and OneWeb suggest that no single separation angle would be appropriate,¹⁰⁰ in order to establish a baseline and promote certainty during in-line event coordination, the Companies support adopting a specific separation angle. This specific separation angle should be less than ten degrees to define an in-line event. The Companies do

⁹⁶ See Kepler Comments at 4; LeoSat Comments at 12-13; *see also* Boeing Comments at 12 (“[T]he Commission should not codify a separation angle of 10 degrees as the appropriate criteria for interference avoidance for all possible NGSO systems and frequency bands. NGSO FSS systems operating in higher frequency bands, particularly the V-band, may generally operate with much narrower beams and better discrimination. Such systems may be able to share spectrum with other NGSO systems using avoidance angles that are smaller than 10 degrees or using some other criteria to avoid interference.”); Telesat Comments at 7.

⁹⁷ See SES/O3b Comments at 25.

⁹⁸ See *id.*; Telesat Comments at 7-8.

⁹⁹ See SES/O3b Comments at 25; Telesat Comments at 7-8. The Companies oppose the views of commenters like SpaceX who propose that the ten-degree angle should be maintained, and oppose the adoption of different trigger angles for different types of NGSO FSS systems. See SpaceX Comments at 19-21.

¹⁰⁰ See Telesat Comments at 7-9 (explaining that the trigger angle will vary among different constellations, and based on the relative position of satellites in constellation to ground terminals); OneWeb Comments at 12-13, 14-15.

not oppose adoption of the two to three-degree trigger separation angle proposed by LeoSat,¹⁰¹ but also submit that an angle of approximately five degrees may be more appropriate for defining in-line events because the angle depends on the antenna diameter and on the frequency. For example, the side lobes for a 0.45 meter antenna operating in the 12 GHz band begin at approximately five degrees from the main axis of the beam, while the side lobes of the same 0.45-meter antenna operating in the 18 GHz band begin at 3.5 degrees from the main axis of the beam. The Companies are not advocating for adoption of a 0.45-meter antenna diameter but rather explaining the rationale for a trigger separation angle between two and five degrees.

O3b and SES oppose OneWeb's proposal to adopt the ITU rule establishing an interference threshold based on a Delta T/T of six percent to define an in-line event.¹⁰² This approach would result in a non-uniform and opaque coordination trigger that could create in-line avoidance angles even greater than ten degrees. This runs counter to the Commission's objective to clarify its rules.¹⁰³ Consistent with its goals in this proceeding, and as supported by parties addressing the issue, the Commission should adopt a single trigger angle smaller than the current ten-degree threshold that is based on current earth station designs.¹⁰⁴

Ephemeris Data. O3b and SES, and many other commenters who addressed the ephemeris data question, support requiring NGSO FSS licensees in the bands currently allocated for, or proposed for, NGSO FSS operations to maintain a website with ephemeris data for each

¹⁰¹ LeoSat at 12-13.

¹⁰² See OneWeb Comments at 14-15.

¹⁰³ See NPRM ¶ 1.

¹⁰⁴ See e.g., Kepler Comments at 4; LeoSat Comments at 12-13.

satellite in its constellation.¹⁰⁵ If the Commission does determine that a third party should manage all the ephemeris data, the U.S. Strategic Command's Joint Space Operations Center is an appropriate entity to do so. However, commenters echo the Companies' concern that requiring operators to submit data to a central database, or requiring ephemeris data to be submitted in a specific format, may be unworkable and the information may become inaccurate, given the large number of satellites proposed for deployment.¹⁰⁶ In that vein, the Companies support Planet's and Spire's proposal for the Commission and the satellite community to engage in a larger discussion of ephemeris data sharing in a more appropriate proceeding, such as the orbital debris mitigation rulemaking.¹⁰⁷

The Commission should not give weight to OneWeb's arguments against sharing ephemeris data on websites.¹⁰⁸ Making ephemeris data available outside of a coordination negotiation encourages transparency that is essential for determining in-line events. Moreover, sharing ephemeris data through traditional coordination channels will likely be insufficient to protect NGSO FSS operations going forward. The multiple new systems proposed in the Ka-

¹⁰⁵ See Boeing Comments at 15; Kepler Comments at 2; Lockheed Martin at 3; Comments of Planet Labs Inc. and Spire Global, Inc., IB Docket No. 16-408, at 4 (filed Feb. 27, 2017) ("Planet/Spire Comments"); Space Norway Comments at 12; SpaceX Comments at 18-19; Telesat Comments at 16. Cf. LeoSat Comments at 13-14 (supporting sharing of ephemeris data through a secure, third-party database).

¹⁰⁶ See SES/O3b Comments at 26. Commenters like Planet Labs Inc. ("Planet") and Spire Global, Inc. ("Spire"), stress that the Commission should "be flexible in how such sharing occurs" and suggest that the Commission's rules should "drive operators to a preferred policy outcome rather than dictating the means." Planet/Spire Comments at 4 (emphasis in original).

¹⁰⁷ See Planet/Spire Comments at 3-4. The Commission has sent NGSO FSS processing round applicants letters seeking information on this issue, so the Commission is also already discussing ephemeris data sharing to some degree in that context.

¹⁰⁸ Cf. OneWeb Comments at 15 ("Although OneWeb does not oppose explicitly requiring market access grantees to make their ephemeris data available to other NGSO system operators, it believes that this website-based approach is overly simplistic and unnecessarily prescriptive.").

band, many of which include a vast number of satellites per constellation, make access to current, accurate information even more important.

Application of Section 25.261. The Commission should also clarify that Section 25.261 applies only to NGSO FSS systems communicating with earth stations with directional antennas operating in U.S. territory.¹⁰⁹ The Companies understand that the proposed Section 25.261 rule for non-U.S.-licensed NGSO satellite systems would only apply to earth stations operating within U.S. territories, and seek confirmation of this interpretation. The Companies further seek clarification that the Commission’s proposal would apply the in-line interference avoidance rule to NGSO FSS systems for protection among NGSO FSS operations and would not apply the rule to GSO FSS networks for the protection of GSO FSS networks by NGSO FSS operations as Lockheed Martin appears to understand.¹¹⁰

2. In-Line Events with Later Entrants

Many commenters support protecting existing NGSO FSS licensees during in-line events as proposed by the Commission.¹¹¹ O3b and SES agree with commenters’ recommendation that the Commission strike the right balance between promoting additional competition and protecting continuity of existing services.¹¹² To achieve this balance, the Commission should require an applicant requesting authority after an initial processing round to protect existing

¹⁰⁹ See SES/O3b Comments at 26. LeoSat supports the Commission’s proposal to clarify that Section 25.261 applies only to NGSO FSS systems that employ directional antennas. See LeoSat Comments at 11.

¹¹⁰ See Lockheed Martin Comments at 2.

¹¹¹ See NPRM ¶ 27; see, e.g., OneWeb Comments at 13; Boeing Comments at 13; Intelsat Comments at 5; LeoSat Comments at 12.

¹¹² OneWeb, for example, opposes allowing later-filed applicants “to avail themselves of the in-line interference mechanism on equal footing with prior processing round licensees and market access grantees.” OneWeb Comments at 13. See also LeoSat Comments at 11.

NGSO FSS systems by ceasing operations on the commonly authorized spectrum during an in-line event.¹¹³ On this issue, the Companies support Boeing’s proposal to impose spectrum sharing requirements only on NGSO FSS systems that receive their licenses (or market access grants) pursuant to the same processing round, or were issued licenses at an earlier date without being subject to a processing round.¹¹⁴ Similarly, the Commission should not require NGSO FSS systems to use the in-line avoidance approach or other spectrum sharing measures to protect NGSO FSS systems licensed pursuant to subsequent processing rounds.¹¹⁵ NGSO FSS operators have expended and are expending considerable capital on their satellite constellations and must have an element of certainty that their investments will not be stranded because of later entrants.¹¹⁶ In addition to capital investments, operators are also dedicating significant resources to coordinating their NGSO FSS systems, as OneWeb notes.¹¹⁷ The Commission should not allow later-filed applicants to undermine these efforts.

3. ITU Date-Priority Processes

Furthermore, the Commission should not adopt ITU date-priority processes like those proposed by Telesat¹¹⁸ and LeoSat.¹¹⁹ Adopting an ITU date-priority system would give earlier-

¹¹³ See OneWeb Comments at 27; *see also, e.g., id.* at 13-14.

¹¹⁴ See Boeing Comments at 13.

¹¹⁵ See *id.*

¹¹⁶ See SES/O3b Comments at 26-27; *see also* LeoSat Comments at 12.

¹¹⁷ OneWeb Comments at 13.

¹¹⁸ See Telesat Comments 14-15 (“In the event that no coordination agreement had been reached, the operator having the lower ITU network priority would be required to avoid harmful interference to a network having higher ITU priority. This process would apply among networks licensed by the Commission or granted market access to the United States, whether they were filed as part of the same processing round or at different times.”).

filed operators an incentive not to reach an agreement with later-filed operators, which may lead to inefficient spectrum use. Instead, the Commission should apply its in-line event rules to NGSO FSS operations in the bands proposed in the NPRM and those proposed by commenters. This will serve as a necessary backstop that will motivate NGSO FSS operators to reach a coordination agreement to avoid band-splitting for their U.S. operations.¹²⁰

D. Earth Station and Space Station Power Limits

Uplink EIRP Limits for Earth Stations. The Commission’s proposal to adopt off-axis equivalent isotropically radiated power (“EIRP”) limits for uplink transmissions for NGSO FSS earth stations is supported by the Companies and several other commenters. Like O3b and SES, several of the parties commenting on the issue recognize that establishing an emissions limit for transmitting earth stations is necessary to establish a benchmark for shared operations and particularly to control emissions at off-axis angles above the in-line event trigger angle.¹²¹ While NGSO FSS operators would always have the flexibility to coordinate different operating levels or conditions amongst themselves, a fallback limit ensures a common understanding among the parties.¹²²

¹¹⁹ See LeoSat Comments at 12 (“The Commission should require NGSO FSS operators to follow the relative priority of ITU filings in situations of in-line interference.”)

¹²⁰ See *supra* Section III.C.1. The Companies agree with OneWeb that band-splitting procedures in Section 25.157(e) are inapplicable to applications granted on condition of compliance with avoidance principles. See OneWeb Comments at 9.

¹²¹ See Lockheed Martin Comments at 4 (“[t]he fixing of [off-axis emission] limits will allow a reduction in the required angular separation between co-frequency non-GSO FSS space station operations, and thus should facilitate sharing and technology neutrality, and preserve opportunities for later system entry”). See also LeoSat Comments at 12-13; Space Norway Comments at 13.

¹²² See, e.g., Space Norway Comments at 13 (“Establishing a set of criteria that NGSO systems must meet would simplify the coordination process and likely result in a more efficient use of

These parties also agree that NGSO FSS applicants should be required to certify that they will abide by the adopted default EIRP limits for uplink transmissions unless higher transmission levels are appropriately coordinated.¹²³ O3b and SES further support Lockheed Martin’s proposal to clarify that an NGSO FSS operator seeking to exceed the default uplink EIRP limits need only certify coordination with other NGSO FSS systems that are “both authorized and operating in the same frequency band.”¹²⁴ Lockheed Martin’s proposed approach is more pragmatic and would remove the difficulties of coordinating with pending or still-evolving systems.¹²⁵

Certain parties oppose adopting default EIRP uplink power limits.¹²⁶ These commenters argue that such limits are premature and unnecessary because proposed and existing inter-operator coordination mechanisms and incentives will adequately prevent inter- and intra-system interference.¹²⁷ The Companies disagree with commenters arguing that NGSO systems and their technical capabilities are not mature and therefore not ready for sharing constraints. On the

these systems.”). While Boeing opposes adopting EIRP uplink limits as being premature, it still acknowledges that limiting the amount of off-axis energy from earth stations communicating in the uplink direction to NGSO satellites “could facilitate frequency sharing among NGSO FSS systems by reducing the required angular separation between co-frequency constellations.” Boeing Comments at 15.

¹²³ See Lockheed Martin Comments at 4; Space Norway at 13.

¹²⁴ See Lockheed Martin Comments at 4 (emphasis in original).

¹²⁵ See *id.* at 4-5.

¹²⁶ See Boeing Comments at 15-16; Telesat Comments at 17; OneWeb Comments at 27-28.

¹²⁷ See OneWeb Comments at 27-28 (urging “existing EPFD_{up} limits set forth in §25.208 are adequate to protect GSO networks from NGSO FSS systems; therefore, off-axis EIRP density limits are not required for this purpose”); Telesat Comments at 17 (arguing EIRP limits on uplink transmissions are unnecessary because ITU coordination requirements should apply to NGSO FSS systems in the Ku- and Ka-bands); Boeing Comments at 15-16 (arguing EIRP limits on uplink transmissions are unnecessary because NGSO FSS system operators have sufficient incentives to appropriately limit off-axis uplink emissions to avoid intra-system interference).

contrary, now is the most appropriate time to adopt uplink off-axis EIRP limits, as they go hand-in-hand with determining in-line events. The rules should be settled before the proposed systems become operational to ensure operators have a clear approach to minimize potential interference among NGSO FSS operators.

Downlink PFD Limits for Space Stations. In the Companies' initial Comments, O3b and SES suggested that there may be too much variance between the different NGSO FSS satellite systems to be able to adopt downlink limits that accommodate all types of operations. After reviewing the comments on the record and further internal consideration of the interplay between in-line events and uplink and downlink operating limits, the Companies support adopting downlink PFD limits. For the avoidance of doubt, these proposed limits are single-entry PFD levels to support NGSO-to-NGSO compatibility and should not be confused with EPFD limits that support GSO-to-NGSO compatibility.

There are two main reasons for the Companies' change in thinking. First, the Companies believe that most operators will design their links to deliver a similar PFD on the Earth's surface. Defining a maximum PFD will therefore not lead to a loss of flexibility in the design of NGSO systems. Second, as discussed above, it is essential to adopt uplink off-axis EIRP limits to ensure that interference outside of the in-line event angle will have a negligible interference contribution. The same rationale exists on the downlink portion. To ensure that interference outside of the in-line event angle is not a problem, a maximum PFD should be defined. The record shows that some commenters support a reduction in the in-line event definition from 10 degrees separation to a smaller value.¹²⁸ This can only be achieved if a maximum PFD limit is

¹²⁸ See *supra* Section III.C.1.

adopted to manage interference outside of the in-line event angle. Otherwise, an in-line event angle will exclude the variation of NGSO FSS system designs such that a dominant interferer could exist outside of the in-line event angle and be excluded from coordination.¹²⁹ Therefore, the in-line event definition only makes sense in combination with a maximum downlink PFD and a maximum uplink off-axis EIRP such that emissions outside the in-line event angle can be excluded from the interference calculations.

IV. OPERATIONAL MILESTONES SHOULD ALLOW FOR PREDICTABILITY AND FLEXIBILITY AMONG ALL NGSO OPERATORS.

A significant number of commenters generally support the Commission's initiative to reconsider its current operational milestones to afford operators greater flexibility in licensing and deploying their proposed constellations.¹³⁰ In proposing modifications to the Commission's specific milestone proposal,¹³¹ or setting forth their own suggested milestone frameworks, however, some commenters appear to have lost sight of the fact that NGSO FSS operators' need

¹²⁹ See, e.g., LeoSat Comments at 12-13 ("Reducing the in-line interference angle . . . will require that the level of emissions at off-axis angles above the trigger angle to be controlled and to not severely impair the link budgets of other systems. For these reasons, the Commission should adopt its proposal to establish off-axis E.I.R.P. limits for transmitting earth stations, as well as downlink power limits to manage incidents of interference outside the trigger angle.").

¹³⁰ See NPRM ¶ 32; SES/O3b Comments at 29-30; Boeing Comments at 17; LeoSat Comments at 15; Lockheed Martin Comments at 5-7; Kepler Comments at 4-5; SpaceX Comments at 14; Planet/Spire Comments at 5; Telesat Comments at 17-18. Even OneWeb, who argues that the Commission should continue to require NGSO FSS licensees to launch and operate the entire authorized constellation within six years, suggests some modifications to the proposal. OneWeb proposes that if the licensee fails to meet this milestone, "the appropriate penalty should be the loss of the operator's surety bond and limiting the authorized constellation to the number of satellites launched, but not the termination of a satellite license" as required by the current rules. OneWeb Comments at 2-3.

¹³¹ Planet and Spire ask the Commission to clarify "whether the newly proposed milestone requirements apply to NGSO systems operating just in the Ku- and Ka-bands or to NGSO systems operating in all frequency bands." Planet/Spire Comments at 5. The Companies echo Planet's and Spire's request.

for flexibility must be balanced against the need for predictability to encourage continued investment in the NGSO FSS sector. Certainty and predictability for satellite operators and investors is even more crucial than in other communications technologies because satellite providers must make significant outlays of capital years in advance of launch and must begin operating their satellite systems before any level of network coverage is achieved.¹³² Satellite operators must be certain that they will have the ability to deploy a sufficient number of satellites to implement their business plans.¹³³

The best way to provide certainty in the milestone context is by adopting clear, unambiguous, quantitative criteria, such as a “milestone requirement that is related to a percentage of operational satellites,”¹³⁴ as proposed by the Commission.¹³⁵ This percentage must take into account the need to prevent warehousing as well as the need for flexibility in initiating service and completing build-out on a viable and sustainable timescale.¹³⁶ While the Commission’s seventy-five percent proposal for the first milestone “may be too ambitious,”¹³⁷ going too far in the opposite direction—as Space Norway suggests with its ten-to-twenty percent deployment at the six-year benchmark proposal¹³⁸—practically strips the milestone requirement

¹³² See SES/O3b Comments at 32.

¹³³ See *id.*

¹³⁴ See Space Norway Comments at 14 (“Space Norway supports having a milestone requirement that is related to a percentage of operational satellites because defining service levels can be difficult and uncertain in some circumstances [S]hould the Commission adopt criteria other than a percentage to measure compliance with these milestones, Space Norway believes that milestones should be based on quantitative and not qualitative criteria.”).

¹³⁵ See NPRM ¶ 32.

¹³⁶ See SES/O3b Comments at 32.

¹³⁷ Space Norway Comments at 14.

¹³⁸ See *id.*

of any meaningful impact. As the Companies have proposed, requiring thirty-three percent of the authorized constellation to be launched and operational with at least one operational satellite in each orbital plane of the authorized system, and scaling back the authorized number of satellites to three times the number of satellites in orbit should an operator fail to meet this milestone, would best reach this balance at the six-year mark.¹³⁹

Achieving the right balance at the nine-year mark is equally important. Proposals that are too onerous, such as Space Norway's proposal to limit an operator's license to the number of satellites launched at the nine-year benchmark if the operator has failed to deploy one hundred percent of its authorized constellation at that point,¹⁴⁰ unnecessarily hinder service expansion and ignore the fact that changes to satellite deployment timelines can sometimes be beyond the licensee's control.¹⁴¹ Too much flexibility, on the other hand, as is reflected in the expanded timeline in Boeing's twelve-year proposal,¹⁴² would similarly disserve the public and Commission by allowing operators to speculate on their spectrum needs, thereby delaying or discouraging market entry. Requiring that seventy-five percent of the operator's authorized

¹³⁹ See SES/O3b Comments at 32.

¹⁴⁰ See Space Norway Comments at 14.

¹⁴¹ See NPRM ¶ 32 n.80; see, e.g., SES/O3b Comments at 30 (citing *Mexican Satellite Lost as Russian Rocket Fails After Launch*, THE WALL STREET JOURNAL (May 16, 2015), <http://on.wsj.com/2m0mMuc>; Stephen Clark, *Citing SpaceX Delays, Inmarsat Moves Satellite Launch from Falcon Heavy to Ariane 5*, Spaceflight Now (Dec. 9, 2016), <http://bit.ly/2mnTVkE>; Chris Forrester, *No End in Sight for French Spaceport Strike*, ADVANCED TELEVISION (Apr. 7, 2017), <http://bit.ly/2pb946a>.

¹⁴² See Boeing Comments at 19-20. NGSO FSS operators that do not launch one hundred percent of their authorized constellation by the twelve-year mark "should have their licenses amended by the Commission to restrict the total number of satellites to those already launched at that point rather than jeopardize the license," according to Boeing. Boeing Comments at 19.

constellation be launched and operational at the nine-year mark strikes the proper balance.¹⁴³

Qualitative standards would be even more problematic than imbalanced quantitative ones from an implementation perspective. Proposals that hinge on ambiguous or uncertain language, such as Lockheed Martin’s “meaningful quality of service” proposal,¹⁴⁴ Telesat’s proposed “substantial, commercially viable service” test,¹⁴⁵ Boeing’s “sufficient satellites” proposal,¹⁴⁶ and SpaceX’s proposed “substantial service” standard for “large” constellations,¹⁴⁷ are likely to result in drawn-out and time-consuming debates that would undermine not only continued investment in the NGSO FSS sector, but also timely service deployment, including to underserved and unserved populations. Adopting the Companies’ milestone proposal avoids these issues.

Other alternative approaches, such as SpaceX’s phased expansion proposal for larger NGSO constellations,¹⁴⁸ are no less problematic from a certainty and predictability perspective. SpaceX attempts to support its proposal, which would treat larger and smaller NGSO FSS systems differently, by arguing that initial deployments of larger NGSO constellations “may require greater investment of resources than complete deployment of many smaller systems.”¹⁴⁹ While this may be correct in some instances, the intent of the milestone standards are to ensure operators appropriately plan and fund the deployment of their proposed systems so that the

¹⁴³ See SES/O3b Comments at 33.

¹⁴⁴ See Lockheed Martin Comments at 6.

¹⁴⁵ See Telesat Comments at 18.

¹⁴⁶ See Boeing Comments at 17-18.

¹⁴⁷ See SpaceX Comments at iii, 13-16.

¹⁴⁸ See *id.* at iii, 15-16.

¹⁴⁹ *Id.* at 15.

spectrum being licensed is put to use in a way that benefits the public.¹⁵⁰ Creating different standards based on the size of a constellation might provide more flexibility to larger constellations but would certainly reduce certainty in the regulatory process.

The Commission has established procedures by which NGSO FSS operators, large and small, can apply to build, launch, and operate NGSO FSS satellites. Larger systems should not be allowed to circumvent this process to expand operations, unnecessarily complicating other NGSO FSS systems' strategic planning and introducing additional uncertainty to new and existing NGSO FSS operations just because of their size. Further, O3b and SES do not agree with ViaSat's proposals for addressing constraints that the so-called "mega-constellations" could impose on smaller NGSO FSS systems.¹⁵¹ The Companies do agree with ViaSat, however, that when considering the various milestone proposals presented by commenters, the Commission should "consider the implications for other NGSO FSS operators, and the sharing environment more generally."¹⁵² In that way, the Commission can ensure that NGSO FSS systems of all sizes are shouldering an equal share of the burdens associated with successful co-existence.

¹⁵⁰ See *supra* at notes 132-133 and accompanying text; SES/O3b Comments at 34-35.

¹⁵¹ ViaSat supports applying the existing "band-splitting" rule rather than the in-line interference procedures during in-line events between smaller NGSO systems and what ViaSat refers to as "mega-constellations," which the Companies do not support. See ViaSat Comments at 22. The Companies do not support band-splitting, except unless all other sharing options have failed. See also discussion *supra* Section III.C.1.

¹⁵² ViaSat Comments at 22 (emphasis omitted) ("Changing the milestone requirements to allow the phased deployment of such mega-constellations—and effectively give their operators an option to deploy a significant percentage of their large constellations (*e.g.*, 25 percent) *after* other NGSO operators have had to make adjustments to accommodate those large constellations—would materially impact the NGSO sharing environment.").

For this same reason, the Commission should also reject Kepler’s proposal to modify the bond requirement so that the amount of the bond increases with the size of the constellation.¹⁵³ Kepler further recommends that “licen[s]es issued to constellations or phases of constellations using 5 or less nano satellites have their bond requirement wa[i]ved after the bringing into use (BIU) of the first satellite.”¹⁵⁴ Although O3b and SES are sympathetic to the challenges faced by smaller companies, in order for the Commission to successfully “facilitate the deployment of NGSO FSS systems” and “spectrum sharing among NGSO FSS systems” as the Commission intends,¹⁵⁵ the Commission must ensure that both large and small NGSO FSS systems operating in the same frequencies are all subject to the same rules. No NGSO FSS operator should receive an unfair advantage—or be unfairly disadvantaged—because of the size of its NGSO FSS system.

Furthermore, the record shows agreement that the milestone requirements should not apply to replacement satellites.¹⁵⁶ As O3b and SES noted in their Comments, these satellites are

¹⁵³ Kepler Comments at 4-5 (footnotes omitted). Specifically, Kepler proposes the following bond requirements: \$500,000 for 1-5 nano satellites; \$5 million for 1-99 satellites; \$10 million for 100-999 satellites; and an additional \$5 million for each additional 1,000 satellites. *See id.* *See also* Planet/Spire Comments at 6-7.

¹⁵⁴ Kepler Comments at 5. Pursuant to Kepler’s proposals, the nano satellite operator “should still be required to follow the recommendation of Space X [sic], tentatively adopted by the [C]ommission, wherein 75% of the system must be BIU by year 6 and 100% by year 9.” Kepler Comments at 5. If a subsequent phase of deployment exceeds the initial five satellite limit, the operator “would be required to follow the normal bond procedure as tentatively adopted by the [C]ommission at the start of its subsequent deployment phase.” Kepler Comments at 5.

¹⁵⁵ NPRM ¶¶ 1-2.

¹⁵⁶ *See* NPRM ¶ 34; SES/O3b Comments at 35; SIA Comments at 9 (supporting the Commission’s proposal to clarify that the milestone requirements of Section 25.164 are inapplicable to replacement satellites); Space Norway at 14; SpaceX Comments at 15 n.30; Telesat Comments at 18. Planet and Spire appear to incorrectly understand that the Commission’s milestone requirements apply to replacement satellites, although replacement

intended to replace existing operational satellites so there is no possibility or concern for spectrum warehousing and a bond requirement would therefore serve no purpose.¹⁵⁷

V. THE NGSO FSS GLOBAL COVERAGE REQUIREMENT SHOULD BE ELIMINATED.

Commenters resoundingly support the Commission’s proposal to eliminate the current requirement that NGSO FSS systems operating in the 10.7-14.5 GHz, 18.8-19.3 GHz, or 28.6-29.1 GHz bands be designed to enable service worldwide for at least eighteen hours every day,¹⁵⁸ and agree that removing this requirement would (1) eliminate an unnecessary barrier to innovation;¹⁵⁹ (2) provide greater flexibility for satellite design and advancement;¹⁶⁰ and (3) allow other operators to capitalize on spectrum made available by operators unable to provide global coverage without sacrificing service quality.¹⁶¹

satellites are clearly exempt from these requirements under the Commission’s rules. *See* Planet/Spire Comments at 8-9; Planet/Spire Comments at 6-7. As the Commission explained in a footnote, replacement space stations “are explicitly exempt from the related bond-posting requirement.” NPRM ¶ 34 n.83; 47 CFR §25.165(a) (“For all space station licenses issued after September 20, 2004, other than licenses for DBS space stations, SDARS space stations, and replacement space stations as defined in paragraph (e) of this section, the licensee must post a bond within 30 days of the grant of its license.”). Further, the Commission proposes to “clarify in section 25.164 that both GSO and NGSO replacement space stations . . . are not subject to the separate milestone requirements in that section.” NPRM ¶ 34.

¹⁵⁷ *See* SES/O3b Comments at 35; NPRM ¶ 34.

¹⁵⁸ *See* NPRM ¶ 35; Boeing Comments at 20-21; Kepler Comments at 5; Lockheed Martin Comments at 7; Space Norway Comments at 14-15; SpaceX Comments at 23-24; OneWeb Comments at 8.

¹⁵⁹ *See, e.g.,* SpaceX Comments at 24; OneWeb Comments at 8.

¹⁶⁰ *See, e.g.,* Lockheed Martin Comments at 6 n.14, 7.

¹⁶¹ *See* SpaceX Comments at 25; Kepler Comments at 5; Norway Comments at 14-15. O3b operates its own system pursuant to a waiver of the global coverage requirement, and Boeing and Space Norway have requested similar waivers. *See* O3b Limited Applications, SAT-LOI-20141029-00118 and SAT-AMD-20150115-00004 (granted Jan. 22, 2015); Boeing Application, SAT-LOA-20161115-00109, Narrative Application at 21, 37-39 (filed Nov. 15, 2016); Space

VI. CONCLUSION.

SES and O3b urge the Commission to adopt the proposals submitted or supported by the Companies in this proceeding. Doing so will expand spectrum access for FSS operations and increase flexibility and efficiency in the use of spectrum. By taking into account the modifications proposed or supported by the Companies—which bring the uniquely balanced perspective of a combined GSO and NGSO FSS operating entity—the Commission can strike the right balance between promoting clarity and certainty and increasing flexibility and spectrum access to for FSS operators.

Respectfully submitted,

O3b LIMITED

Ari Q. Fitzgerald
Camillie Landrón
HOGAN LOVELLS US LLP
555 Thirteenth Street, N.W.
Washington, DC 20004
(202) 637-5423
Counsel to O3b Limited

By: /s/ Suzanne Malloy
Suzanne Malloy
Vice President of Regulatory Affairs, O3b Limited
Mariah Shuman
Director, Maritime & International Regulatory
Affairs, O3b Limited
O3b Limited
900 17th Street, N.W., Suite 300
Washington, DC 20006
(202) 813-4026

SES S.A.

By: /s/ Petra A. Vorwig
Petra A. Vorwig
Senior Legal & Regulatory Counsel
for SES S.A.
1129 20th Street N.W., Suite 1000
Washington, DC 20036
(202) 478-7143

April 10, 2017